

# PATHWAYS

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## BENEATH THE SUDS

Most children know that soaps and detergents help to get rid of grease and oil on hands and dishes, but probably few know how they do it. With two immiscible (unmixable) liquids such as oil and water, and a small amount of detergent, pupils can find out for themselves what happens beneath the suds.

See that each pupil has a small, screw-cap glass jar, a toothpick, and a paper towel (in case of spilling). At one side of the room place several small jars containing groundnut oil and other cooking oils, each with a dropper, and a few jars containing small amounts of detergents. Ask each pupil to fill his own jar two-thirds full of water and add 10 to 20 drops of oil. Then have him take his jar back to his seat to investigate as follows :

Does the oil float, or sink, or does some float and some sink? If some is pushed underwater, what happens to it? If the oil is stirred gently, does it mix with water? Cover the jar, shake the oil and water, and let it stand. What happens to the droplets? Can you tease them back together again?

Now dip the toothpick into a jar of detergent, and then touch it to the center of the water in your jar, watching carefully as you do so. What happens at the oil/water surface.

Cover the jar; then shake the oil and water a few times. Hold the jar up to the light and observe the contents carefully, using a magnifier if one is available. Are there more or fewer droplets of oil than before? Are they larger or smaller? Add a tiny bit more detergent, shake the mixture, and observe it once more. What change can you see in the number and size of the oil droplets? Also try other substances such as motor oil, kerosine, and butter.

Detergents and soaps help to break oil and grease into tiny droplets. When the droplets are small enough, they do not stick to hands and dishes, but wash away easily in water.





# STUDYING THE THERMAL EXPANSION OF WIRES

—A Science Project

by Lalit Kishore

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## Construction and Development

A simple apparatus to study the thermal expansion of different wires can be constructed as follows.

Take a wooden plank (100 cm x 100 cm x 2 cm) and fix two 5 cm long nails on one side of it. At the other end of the plank fix a U-shaped metal piece with small holes in its two limbs. Pass a darning needle through the holes in the metal piece. The needle should be able to rotate freely in the holes. Fix a straw pointer to the darning needle and place a scale behind the straw. Fix a wood piece (1m x 1m x 0.2m) to the back of the plank.

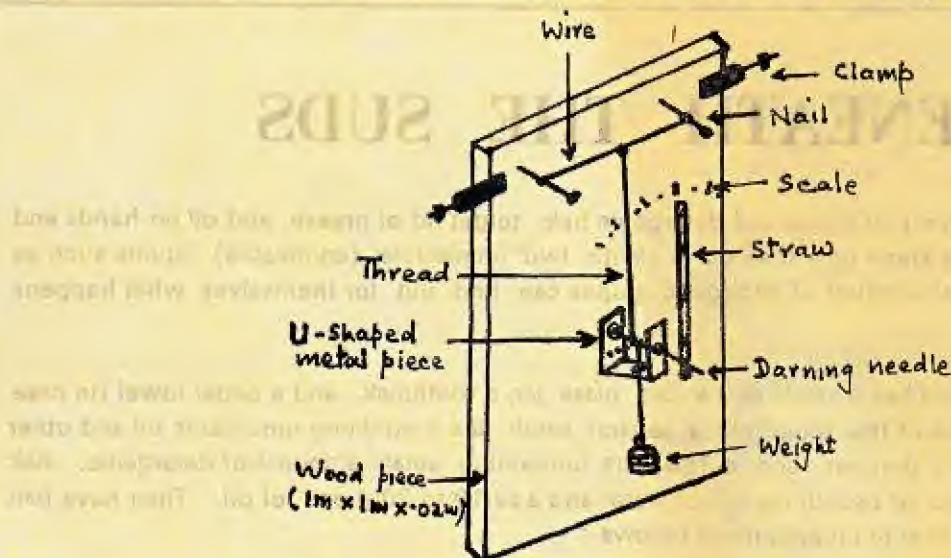


Figure : Set-up for thermal expansion of wire.

Take a wire (28 SWG, resistance wire) and tie the ends of it to the nails and tie a piece of thread to its centre. Pass the thread over the needle giving a turn around the needle and tie a weight of 200 g to the free end of the thread as shown.

Either heat the wire using a flame for a fixed time interval or pass current (1 Ampere or more) through the wire. As the wire expands, its linear movement will be converted into rotation of the needle and the pointer.

## Activities

1. Investigate the expansion of the wire with the extent of heating.
2. Investigate the expansion of wire made of a given material by heating with different flames for the same time.
3. Investigate the expansion of wires of different materials.



# THE ADVENTURE OF TEACHING

by Sr. Laurette, S. N. D. (Patna)

"The word adventure connotes a positive undertaking, like discovering the source of the Nile River or scaling Mount Everest. It involves struggling to meet challenges: limited human energies, diseases, difficult or dangerous terrain, extremes of heat or cold. In meeting challenges there are advances and reverses, successes and failures. Adventure entails planning ingeniously, mustering courage, attempting, failing, revising strategy, renewing courage, trying again, and persevering through challenge after challenge until the goal is reached. The outcome of adventure is uncertain: challenges to progress along the way may not be overcome, the final attempt at the goal may fail. Adventure means taking risks and requires daring, courage, patience, and perseverance. It means achievement, at least the very struggle with opposing forces, but also completion of part of the journey and eventually attaining the goal. Adventure is stimulating and exciting; it gives zest to life and a feeling of satisfaction."

—Christopher Kiesling

Some people are bored by life and fail to see it as an adventure; some teachers are bored by their profession and miss the joys of adventuresomeness in it. Teaching, like living, can be a positive undertaking; it all depends on our attitude. This may come as a surprise to those who have let themselves drift into mediocrity in their role as teachers, those who feel burdened by the ordinariness of their work and the daily drag of preparation, teaching from a textbook, correcting assignments and examinations. But is that the fault of the profession, or have we let ourselves drift into a certain attitude about our commitment to education? Let's look a little more closely at what is meant by "adventure" in the life of a teacher.

.....It involves struggling to meet the challenges of limited human energies. None of us has the energy of the five, ten, or fifteen-year-old students we meet each day. We find ourselves more and more limited in our energies. Or perhaps we are diffusing our energies instead of directing them toward the goals of education in our own small world of the classroom. But even if we are able to direct our energies and use them well, there will still be times when we feel that we are limited, when we are expending so much energy that we are drawing on our reserves. The miracle is that we do have these reserves on which to draw. Another miracle is that if we love our teaching, if we are really committed to helping our students open their minds and hearts in order to absorb knowledge and understanding of themselves and their world, then we don't mind being tired at the end of the day—and especially tired at the end of a full week of teaching.

..... Meeting diseases in our teaching is something we forget about, but we often have to cope with children who are ill, and we may contract an infectious disease such as chicken pox or measles or perhaps something more. Worse yet, we may become infected by the disease of boredom or of neglecting our preparation and correction work—diseases which we sometimes see afflicting other teachers in the school community.

..... Is there any difficult or dangerous terrain in teaching? What could be more difficult than helping a slow student learn to understand and to make the effort to try a little harder? The terrain can also be full of dangers when our students ask questions which we are unable to answer, or when we find that they have grasped the matter better than we and are able to move along in their learning at a faster pace than we are willing to go.



As we meet these challenges there are advances and reverses; we find ourselves sometimes moving forward and sometimes lagging behind; we may find that there are times when our efforts bring successes, but at other times, at the price of tremendous effort, we still manage somehow to fail. Is there any real adventure that always succeeds? If we could be certain of success there would be no adventure. The very word ADVENTURE means that there is the risk of failure as well as the possibility of success. If every team climbing Everest knew it would succeed, there would be no adventure connected with it. The adventure consists precisely in recognizing the risks, in seeing the possibility of failure, and in being ready to accept it, to learn from it, to get up after the failure and start again.

..... Adventure entails planning ingeniously, not just writing out a plan so that we have something to present to the Principal on Monday morning. It consists in being creative, in looking for alternative ways of approaching lessons which we have taught before. Planning ingeniously means looking at the same old thing from a new angle, through new approaches, so that we don't get bored in teaching any more than the children get bored in being taught. Planning this way requires that extra effort which tends to make a teacher a success more often than a failure.

..... We must have courage in order to get up and begin again after we have attempted something and failed. There are times when we also need to muster courage to face another week or an especially difficult class. It takes courage to smile, to listen, to be enthusiastic when we are tired or have a headache or after a depressing failure.

..... Our failures teach us something, if we but take the time to look at them, to reflect on them and learn from them. It has been said that reading without reflection is like eating without digestion; so it is with life. If we live and work without reflecting on what is happening to us, if we allow ourselves to get pulled down by our failures and do not reflect on them so that we use them as stepping stones to a future success, then we are "eating without digesting". As we reflect on what failed in our lesson or in a situation with a student, we soon begin to realize that we must evaluate what happened and revise our strategy so that there is less risk of failure next time, more possibility of success. If we fail once and yet continue to act in the same way, we are setting ourselves up for another failure. There are groups which have failed in their attempt to reach the peak of Everest. Some gave up because it seemed like too much trouble to review the strategy of their ascent and to try another way up to the top. But those who saw the climb as a challenge and looked forward to the adventure of reaching the peak were willing to try again and again—and finally they succeeded.

..... Viewing our teaching as a challenge means that we are sure of what our goal is and are willing to persevere through challenge after challenge in order to reach it. A person who does this is no longer a bored or boring teacher, but is an adventurous educator. The goal must be clear; then comes the realization that there may be many ways to reach it. After all, "Many roads lead to Rome", so the saying goes—and many roads lead to a goal. If one road isn't good but we really are aiming at something important then it's worthwhile to try another. Or perhaps we can just try another way of travelling along the same road. We really have many alternatives open to us once we let ourselves see the possibilities.

Some people have a hundred acres of possibilities,  
and about a half-acre under cultivation.



The possibilities are there, or better yet, they are here before us. The adventure is in finding them and using them. When we do, this, then our teaching becomes an ADVENTURE. Would you like some adventure in your life? Would you like to enjoy the thrill of being an adventuresome person? an adventuresome teacher? Now is the time to begin. Once we put off till tomorrow what we really could and should do today we lose the spirit of adventure in our teaching—and in our living. There is no one who need be bored because we don't make the effort to see the challenge and take the risks which separate the bored and boring teachers from the exciting and creative and enthusiastic ones.

TEACHING IS AN ADVENTURE THAT IS STIMULATING AND EXCITING; IT GIVES ZEST TO LIFE AND A FEELING OF SATISFACTION.



## Have You Heard About.....?

- \* **TEACHER TALK**—The newsletter of the Progressive Educational Techniques Society (Teacher's Centre), 7, Middleton Row, Calcutta-700 071. Their second issue, just released, and priced at Rs. 3/- is on the Monsoons. It has a topic web and large number of suggested activities suitable for Junior, Middle and Senior School. They would also welcome contributions for publication from teachers.
- \* **NATURE STUDY PROJECTS FOR JUNIORS**—a set of eleven interesting worksheets titled Trees, Birds, Mammals, Seeds, Activities in Woods etc. They are available from the Division of Educational Services, National Museum of Natural History, Barakhamba Road, New Delhi-110001. While some activities are to be carried out during a visit to the museum, others are possible in a wide variety of environments. Also available from the Museum are
- \* **A WINDOW TO ECOLOGY—CHILDREN'S WORKBOOK**
- \* **A SET OF POSTERS ON THE ENVIRONMENT.**
- \* **IDEAS AND ACTIVITIES IN HISTORY**  
A cyclostyled booklet costing Rs. 3/- only, compiled by a group of innovative teachers of History and published by the Teachers' Centre, Ramjas School, Sector IV, R. K. Puram, New Delhi-110024.  
The activity cards include questions ranging from the ancient period up to Modern India. The last card is based on Attenborough's film 'Gandhi'. Suitable for children in the Middle School.

## Minni and Kaku

A collection of motivational songs for children on health and hygiene themes. The present series has been produced in Hindustani. An effort has been made to make these songs fun to sing. Some are in dialogue form and can be dramatised. They have been set to music by Madhulika Saran and recorded on cassettes. They could be used during singing lessons, as part of science and health education classes and even as part of language learning. For further information contact:

UNICEF Information Service  
73-74 Lodi Estate

New Delhi-110003



# Parts of Speech

Calling teachers of English from amongst our readers. We are sure you will enjoy this exercise (quiz?) Select the word or phrase nearest in meaning out of the three choices given against each abstract noun in the given list.

1. CHICANERY —A : foolishness. B : low trickery. C : hatred
2. AVARICE —A : envy B : generosity. C : greed
3. BIGOTRY —A : pride. B : morbid dislike. C : unreasoning attachment to one's opinions
4. BRAVADO —A : servile praise. B : state of well-founded happiness. C : pretense of bravery
5. TENACITY —A : persistence in holding fast B : prejudice C : sympathy
6. ASCETIC —A : an artist B : a self-denying person C : an ambitious person
7. OPULENCE —A : maudlin praise. B : generosity C : wealth
8. MUNIFICENCE —A : luxuriance B : liberality in giving C : flattery
9. COMPUCTION —A : stubborn adherence to ideas. B : ambition C : sense of guilt
10. SURFEIT —A : intense dislike B : oppressive fullness. C : fraud
11. FELICITY —A : affection B : blissful happiness C : gratification beyond desire
12. ADULATION —A : hatred B : boasting C : excessive praise
13. MENDACITY —A : threat of danger. B : lying C : joy
14. ANTIPATHY —A : aversion or dislike B : forgiveness C : toughness

From 'Six Weeks to Words of Power' by Wilfred Funk.

Answers : 1-B; 2-C; 3-C; 4-C; 5-A; 6-B; 7-C; 8-B; 9-C; 10-B; 11-B; 12-C; 13-B; 14-A.

## GETTING-TO-KNOW-EACH-OTHER-BETTER GAMES

Since most schools tend to retain children in the same section every year, classmates know each other well by the time they reach the upper primary school. However, the following games still unearth quite a few surprises. The pupils enjoy them and the observant teacher can learn a lot about social relationships through them.

### IS HE/SHE RIGHT ?

Each pupil in turn stands up. The other children, 'best friends' excluded, have to mention two things he likes and two he dislikes (e.g. Amitabh Bachchan and ice-cream or maths and spinach). The pupil who is being discussed has to verify or disagree. This usually shows up how ignorant we can be about daily companions. It makes the children more aware of each other.

### I LIKE HIM/HER BECAUSE ..

Each pupil in turn stands up. The others give reasons why they like him or her (I like her because she shares her things..she is kind etc.) Both these games are ideal for moral science class.

ANJUM KATYAL

(Reproduced from Teachertalk, the Newsletter of the Teacher's Centre, Calcutta)



# Two Simple Demonstrations in Chemistry

Science texts state "Energy has many forms" and go on to explain in later stages that chemical reactions involve energy changes. Here are two interesting, yet easily managed chemical changes, which your students may safely try out on their own, in small groups.

Place on each table the following items :

two test-tubes with stoppers

a test-tube stand

small bottles containing calcium chloride ( $\text{CaCl}_2$ ) and ammonium nitrate ( $\text{NH}_4\text{NO}_3$ )

distilled water

Under your instructions, the students can, in turn, dissolve these two chemicals in the water, close the test-tubes and shake them. The test-tube containing the calcium chloride becomes quite warm. Compare this reaction to the burning of gas in a burner or the burning of a candle. All these chemical reactions produce heat.

The second test-tube containing the ammonium nitrate becomes 'colder'. Point out that the test-tube absorbs heat from the environment. It is not a case of production of 'cold' by the chemical reaction. Thereby, another important concept comes across—loss of heat means lowered temperature, what we describe in everyday language as 'cold'.

Remind your students to wash their hands well after the experiments.

\* \* \*

## Wrong Answers are the Key to Learning

A Canadian educator, J. W. Powell, has, through a careful study of wrong answers, discovered that he considers a crucial flaw in the educational system that leads to an artificially low ceiling on student achievement. Powell believes that "of the two types of learning, only the 'computer type'-with its emphasis on information storage has been rewarded. Information processing has been neglected".

Teachers listen for the expected answer rather than listening to the answer they get. The child who cannot frame his or her own ideas the way the teacher does, very quickly becomes a 'failure'. When students learn to detect the errors in their own processes, they move ahead very quickly.

"Once I started to teach them from the points of view they were using, a surprising thing happened. Both their enthusiasm and their performance made a large jump forward."

Sometimes children's answers are not wrong at all. A teacher asked her class to draw a robin's nest with seven blue eggs in it. One child, having learnt elsewhere that robins never lay more than five eggs at a time, drew only five eggs in the nest.

The effective problem solver is flexible and learns to select a strategy appropriate to a given problem.

—based on a report in THE HOLISTIC BULLETIN  
Volume I, No 1.



# TONGUE TWISTERS

Some of these are old favourites; others you may not have heard. Try them yourselves. Read them. Repeat a little faster..... and faster..... Not as easy as they seem. And then see what your pupils make of them.

- \* Betty Botter bought a bit of butter. "But", she said, "this butter's bitter. If I put it in my batter, it'll make my batter bitter. But a bit of better butter'll make my batter better."

So Betty Botter bought a bit of better butter and it made her batter better.

- \* Three grey geese in the green grass grazing : gray were the geese and green was the grazing.

- \* The seething sea ceaseth, and thus the seething sea sufficeth us.

Try saying this one clearly, without any mistakes in less than twenty seconds.

- \* I bought a batch of baking powder and baked a batch of biscuits. I brought a big basket of biscuits back to the bakery and baked a basket of big biscuits

Then I took the big basket of biscuits and the basket of big biscuits and mixed the big biscuits with the basket of biscuits that was next to the big basket and put a bunch of biscuits from the basket into a box.

Then I took the box of mixed biscuits and a biscuit mixer and biscuit basket and brought the basket of biscuits and the box of mixed biscuits and the biscuit mixer to the baker—and opened a tin of sardines.

All tongue twisters need not be long and they could help your diction !

- \* The sixth sheik's sixth sheep's sick.

- \* She stood on the balcony, inexplicably mimicking him, hiccuping and amicably welcoming him in.

- \* Fanny Finch fried five floundering fish for Francis Fowler's father.

- \* Amidst the mists and coldest frosts,  
With barest wrists and stoutest boasts,  
He thrusts his fists against the posts,  
And still insists he sees the ghosts,

You must have heard others similar to this one.

- \* Theophilus Thistle, the thistle-sifter, sifted a sieve of unsifted thistles. If Theophilus Thistle, the thistle-sifter, sifted a sieve of unsifted thistles, where is the sieve of unsifted thistles Theophilus Thistle, the thistle sifter sifted?

Shorter still, but just as deceptive Try repeating these thrice in quick succession.

- \* The old cold scold sold a school coal scuttle.
- \* Six long slim slick slender saplings.
- \* Slippery sleds slide smoothly down the sluice-way.
- \* She sell sea-shells by the sea-shore, And the shells she sells are sea-shells by the sea-shore.
- \* A bloke's back brake block broke.



# Asking Meaningful Questions in Science

Science Education has four broad goals.

1. To develop student's attitudes of curiosity, of wonderment about and involvement with phenomena in their natural environment; to develop an appreciation of the contributions of science to daily living; and to develop the value and inclinations toward solving problems in a scientific manner.
2. To develop those intellectual processes of inquiry by which scientific problems and phenomena are explained, predicted and/or controlled.
3. To develop knowledge of facts, terminology, concepts, generalizations and principles which help the students confront and interpret their environment.
4. To develop the student's skills, his ability to handle, construct and manipulate materials and equipment in a productive and safe manner, and to develop his ability to measure, organise and communicate scientific information.

While planning your lesson it may be easier to remember the four key words—ATTITUDES; PROCESSES; KNOWLEDGE; SKILLS. These sum up what a teacher is aiming to develop in the child. It is important to note that as a result of the learning experience, the teacher expects a behavioural change in the child. Obviously, changes must take place in all the four areas listed above.

Most of our lessons are planned on the basis of written material available to the teacher in a prescribed textbook. Often the main concepts contained in a lesson are summarised at the end. Actually, this has tended to become a disadvantage rather than an advantage. We frequently give in to the temptation of testing the students only on these facts (knowledge). As a result, little progress is made in the other areas. Attitudes and skills are developed by giving students opportunities for working on their own and in groups; by asking them to find out for themselves through experiments, practical experiences and from other sources.

This article deals mainly with the questions we use in testing our students. You are aware that cognitive learning takes place at many levels. The higher levels of learning include interpretation, analysis synthesis and evaluation. However, in our day-to-day questioning we must certainly be constantly aware of at least the first three levels, namely :

- i. **Knowledge**—i.e. recall of definitions, statements, laws etc.
- ii. **Understanding**—i.e. Using the facts in known situations or to explain known phenomena.
- iii. **Application**—using the facts to explain new events. This is a part of training the child to think.

Hence the types of questions we use in testing are important.

Before discussing this aspect, here are a few more questions for you.



## ASK YOURSELF :

- \* What kind of answer do I expect ? Is it a statement memorised from the text ? Is it to be an explanation in the child's own words ? Is it to be a drawing—learnt from the text or something original created by the child ?
- \* Have I asked (discussed/taught) the same question in class ?
- \* Have I done a similar question in class ? How is this one different ? Are the numbers different in the sum ? Is the situation slightly different ?
- \* Have I given enough Information to help an average student solve the problem ?
- \* Have I given too many clues to the answer ? Does the child have to think or not ?
- \* Is the question correctly worded ? Can it be easily understood ? Is the language within the capacity of the average student ?
- \* Could I have framed the same question in a more interesting or unusual way ?

I have attempted to give examples suitable to either the upper primary or middle school classes. Obviously children would need classroom practice in the various kinds of questions before facing them in a test.

Here is a selection of different types of questions we might use.

- I. 'Fill in the blanks' is a very commonly used type of question. At lower levels the words may be selected from a given jumbled list. For older students the words may not be given at all. Take care to ensure,

either that only one particular answer is the correct one,  
or that you accept what the student fills in, if the fact is correct, even if it differs from the textbook.

For example:

'..... and..... are foods that keep us healthy'. may have many different answers. In fact, it is a good idea to encourage children to write words of their own choice in this kind of question.

- II. Matching words or phrases given in two columns may be made very straightforward or may involve some thinking. Study the examples below.

Example 1 :

### Column A

- i. respiration
- ii. digestion
- iii. excretion

### Column B

- a. giving out waste substances
- b. breathing
- c. breaking down of food

Example 2 :

### Column A

- i. wool
- ii. cotton
- iii. silk

### Column B

- a. Plant
- b. cocoon
- c. sheep

Example 3 :

### Column A

- i. root
- ii. stem
- iii. leaf
- iv. bud
- v. fruit

### Column B

- a. produces food
- b. contains seeds
- c. grows into a flower
- d. grows underground
- e. carries minerals and water to different parts



**Example 4 :** A school boy fixes a tall stick in the playground and observes its shadow. Match the following.

- At
- 7.00 a.m.
  - 7.00 p.m.
  - 3.00 p.m.
  - 12.00 noon
  - 8.00 a.m.
  - 4.00 p.m.

The shadow is in

- the West
- the North
- the West
- the East
- no shadow
- East

These exercises can be used to check on the definitions of words, and functions or relationships of selected terms. Note how the last question involves application of certain known facts.

III. Another commonly used type of question asks students to indicate if a number of given statements are "true or false". A modification of the same may ask students to re-write the incorrect sentences with the necessary corrections.

Care must be taken that there is no set pattern in the arrangement of the sentence e.g. TTFTTTF or TFTFTTF. Also the number of 'false' statements should be approximately the same as the number of 'true' statements.

IV. Multiple-choice questions invite the student to select the correct answer from a given list. Here too care is needed to ensure that the correct answers are not always in the same pattern. Here are some examples of this type of question.

Underline (or tick) the correct answer in each case.

**Example 1.** Plants produce their food in the stem; the leaf; the bud; the fruit

**Example 2.** Which of these is not a hinge joint? the wrist; the elbow; the ankle; the shoulder.

**Example 3 :** The hinges of creaking doors are oiled to : . . . .  
reduce noise; keep them black; keep them clean

**Example 4 :** Which of the following statements is true ?

- \* Plants need sunlight and air to make their food
- \* Plants need sunlight and water to make their food
- \* Plants need sunlight, air and water to make their food
- \* Plant need air and water to make their food

Observe that the statements differ only slightly and must be read carefully in order to select the correct answer.

**Example 5 :** Find the word that does not belong in each group.

- \* fish, tiger, deer, bear.
- \* rose, petunia, gulmohar, jasmine.
- \* honey, milk, kerosene, air.

This involves students in a simple form of classification (see also VII)

To make children think, they could be asked to give reasons for their answers,

Here are samples of a type of multiple choice question which is generally to be reserved for older children. Underline only one correct answer.

**Example 6.** All acids

- contain hydrogen atoms
- form one or more series of salts
- turn blue litmus red
- all the above



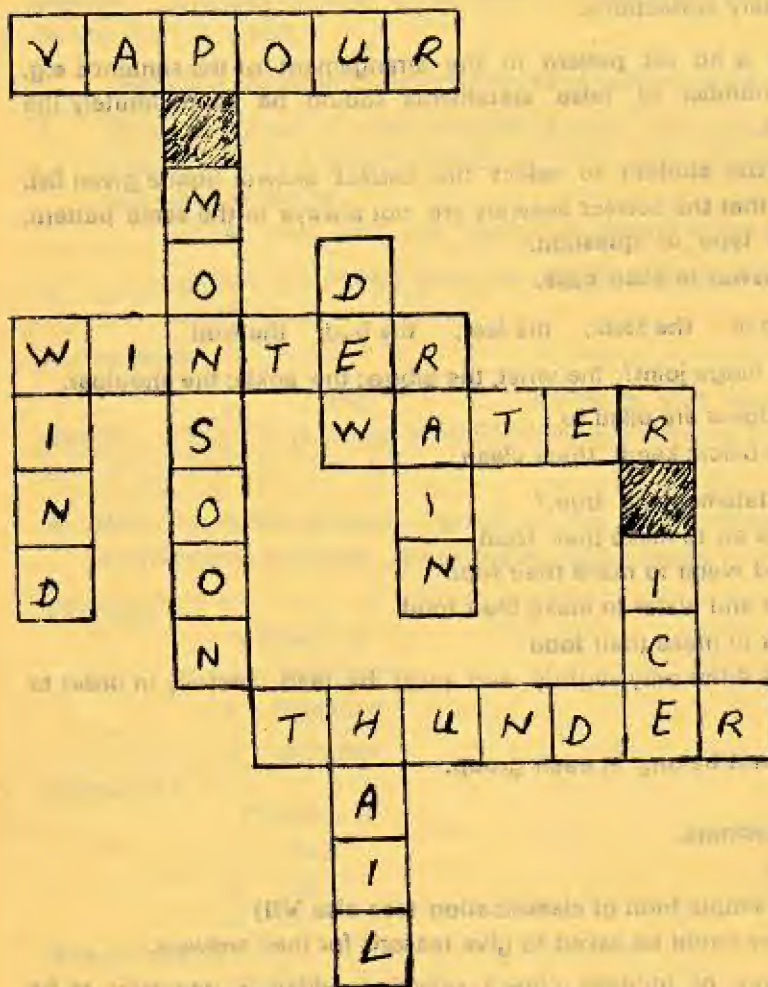
**Example 7. Oxygen gas is**

- i. greenish in colour
- ii. very soluble in water
- iii. inflammable
- iv. none of the above

V. The use of word—puzzles and crosswords provides an interesting way of checking up on new vocabulary, definitions and simple facts.

Here is a simple word puzzle using vocabulary based on the weather. The boxes may be numbered and clues given. If needed a few of the letters can be filled in

Would you like to make up the clues?



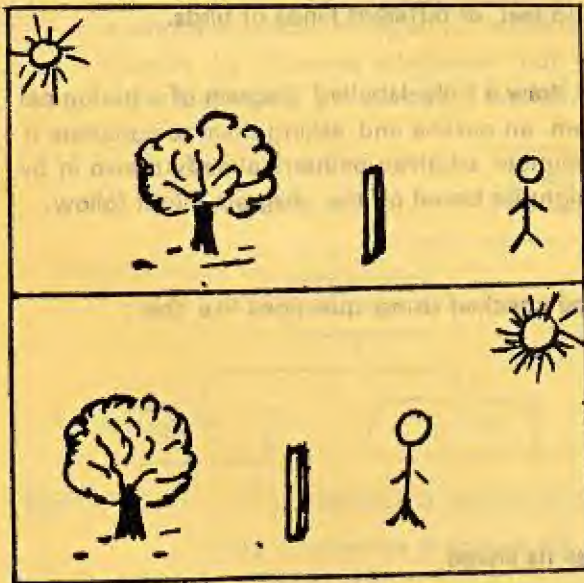
Note the following points when you make a crossword. Number **all** the words serially before you number the clues. No number is to be repeated. Remember that if a horizontal word and a vertical word start in the same box they will have the same number. The clues will then be labelled (for example) as 2 Across and 2 Down.

VI. Pictures also make questions more interesting. The drawings need not be elaborate and children can answer on the same sheets if needed.

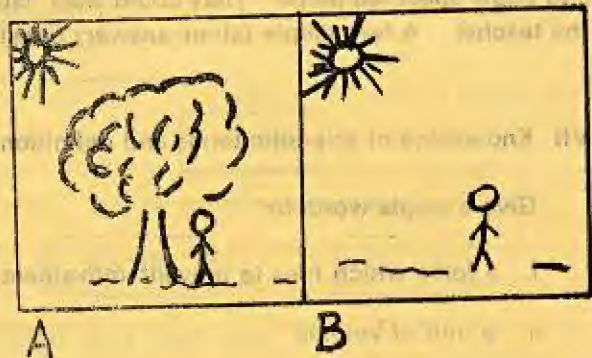
A tip: Look for simple shapes and stick figures in magazines and newspapers. Practice tracing them and modifying them to suit your needs.



The following exercises are taken from an article by Mrs. Saroja Srinivasan in an earlier issue of Pathways. Observe the varying levels of difficulty.

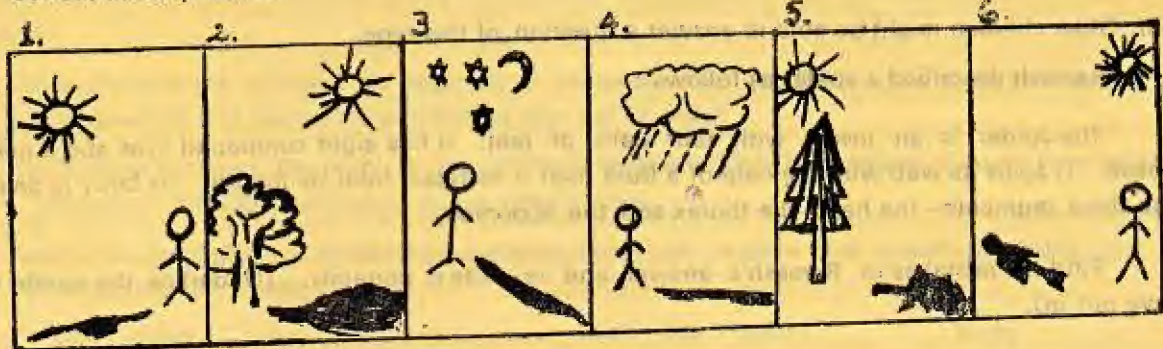


i. Draw the shadows of the things in the pictures shown alongside. Look at the position of the sun.



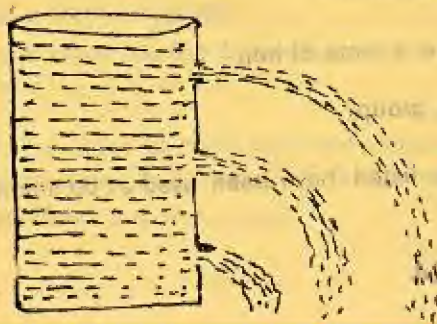
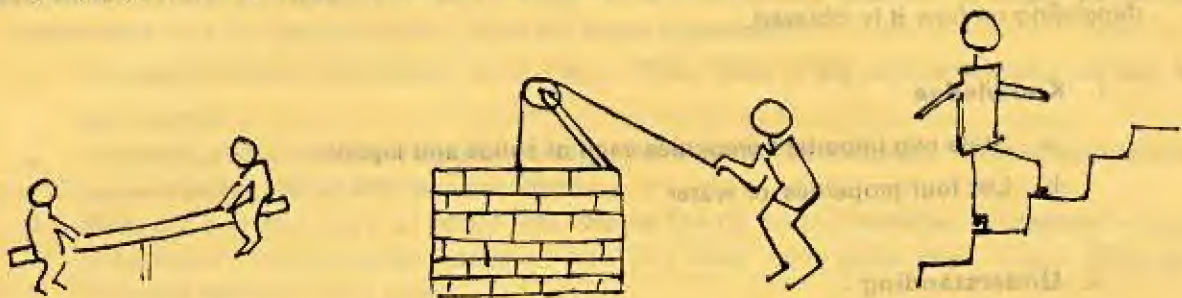
ii. Which body will have a shadow? Why?

iii. Correct these pictures.



Look at these exercises also.

Q. Which of the four simple machines—pulley, lever, inclined plane, screw—is being used here?



Q. Find the mistake in this drawing



You can trace the pictures or illustrations in a text-book and base your questions on them.  
e.g. One suitable topic is the functions of the beaks and feet of different kinds of birds.

Talking of pictures, pupils are often asked to draw a fully-labelled diagram of a biological specimen or some apparatus. What about giving them an outline and asking them to complete it and show specified parts? They could also label a number of given pointers already drawn in by the teacher. A few simple (short-answer) questions might be based on the diagram might follow.

**VII** Knowledge of scientific terms and definitions can be checked using questions like this :

Give a single word for

- i. a force which tries to prevent movement
- ii. a unit of volume
- iii. a single-celled animal which constantly changes its shape

**VIII.** Older children might be able to answer a question of this type.

Ramesh described a spider as follows :

The spider is an insect with four pairs of feet. It has eight compound eyes and a pair of feelers. It spins its web with the help of a fluid that it secretes from its mouth. Its body is divided into three segments—the head, the thorax and the abdomen.

Find the mistakes in Ramesh's answer and re-write it correctly. (Underline the words you have put in).

**IX.** The following type of question involving classification can be used at three different levels, depending on how it is phrased.

i. **Knowledge :**

- a. State two important properties each of solids and liquids.
- b. List four properties of water

ii. **Understanding :**

Classify the following substances into two groups.

water, stone, milk, honey, wood, kerosene, a lump of iron

What are the common properties of each group?

It is presumed here that all the substances listed have been used as common examples of the properties of solids and liquids in class.

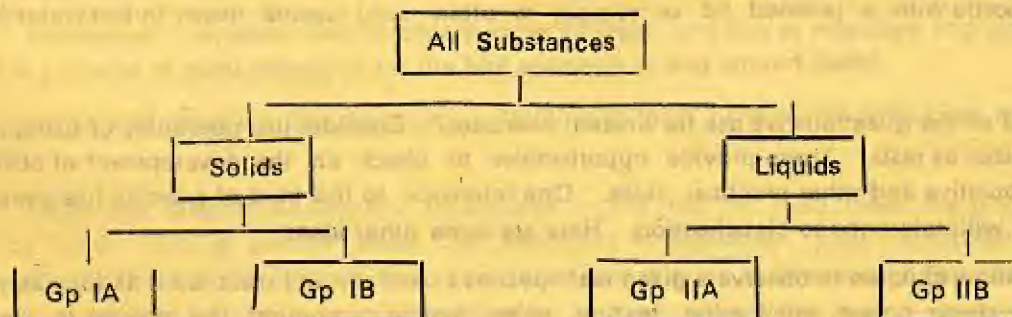


### iii. Application

A similar question, using some examples not referred to previously.

Classify the following substances into groups as shown in the diagram :

a block of wood, gum, water, a feather, milk, honey, a sheet of paper, a lump of iron



Explain how (1) the substances in groups IA and IB differ from each other.

(2) the substances in groups IIA and IIB differ from each other.

Exercises of this kind help in developing the skill of discrimination. They can even be carried out as a practical exercise using collections of objects which children can feel, touch and explore.

X. When children are required to describe a process, it is possible to give them a collection of jumbled words and sentences which they can put in order.

e.g. Place these parts of the body in the correct order in which food passes through them during digestion : intestines, stomach, gullet, mouth, anus.

XI. Testing a knowledge of relationships between terms can be done with questions of this type. Fill in the missing words :

\* cow : grass :: lion : \_\_\_\_\_

\* fins : fish :: \_\_\_\_\_ : birds

\* stomach : \_\_\_\_\_ :: lungs : respiration

\* \_\_\_\_\_ : botany :: animals : zoology

XII. Questions which are based on familiar real-life situations help children to apply the factual knowledge they have been taught. Here are some examples.

1. Anu bought some cut-flowers at a shop. What parts of the plant would she not see in her flowers?

2. You have added an extra spoon of sugar to your tea, by mistake. You do not want to throw it away. What will you do? Why?

3. Write out a simple menu of what you would like for lunch tomorrow. Explain what type of foodstuff (carbohydrates, proteins, fats etc) each item gives you. Is any important foodstuff missing in this meal?

It is important to give students opportunities to express themselves in their own words--even if only in a short paragraph!

4. A shopkeeper has the following weights; 1kg, 2kg and 5 kg. How will he give a customer  $3\frac{1}{2}$  kg of rice?

5. Ahmed wanted to make jam sandwiches but could not open the bottle. His mother held it upside down in hot water for a few minutes. He was then able to open it easily. Why do you think this happened?



The use of names for people and places makes it easier for the young student to relate such questions with his personal experiences. You can notice the difference when you read the last question phrased this way :

Give reasons for the following :

A bottle with a jammed lid or stopper is often held upside down in hot water for a few minutes.

**XIII. Need all the questions we ask be written exercises?** Consider the possibility of using practical exercises as tests. These provide opportunities to check on the development of observation, manipulative and other practical skills. One reference to this kind of exercise has already been made with reference to classification. Here are some other ideas.

- i. Allow children to observe a given leaf specimen carefully and describe it as fully as possible —shape, colour, smell, edge, texture, veins, simple/compound (be careful to give them a full twig), name (if common). Recording could also include a careful drawing of the specimen.
- ii. Exercises involving measurements (length, area, volume, time) could use actual objects. For example measure the length of pieces of string rather than lines drawn on paper. Obviously for your own convenience, the strings would be of different colours, cut in three or four standard sizes, which would be distributed in a random manner in the class.

Likewise children can measure the lengths of rooms, verandahs etc. to give answers in metres and centimetres. Here, you would know the precise answer, but would make a reasonable allowance for experimental error in checking their answers.

- iii. Pairs of almost identical pictures with minor differences between them are often found in children's magazines. Others may have deliberately introduced mistakes. Finding these provide exercises in careful observation.

Tests of this type, especially those containing objective style questions, do take longer to set, but the time spent in careful planning is compensated for by the ease of correction. Also, marking becomes uniformly impartial for all students.

Apart from these objective style questions, as children master the ability to write (preferably in their own words) they need practise in

- \* questions having answers of one or two sentences,
- \* questions having answers of five or six sentences, that is one short paragraph
- \* questions having longer answers, e.g. those which describe a process, an organ system or an experiment

One last word about questions. We frequently carry out oral testing while we teach, both during and after a lesson. Be careful to avoid the easy way out of

- i. either directing your questions only towards the "bright sparks" whose hands are promptly and always raised in response, or
- ii. becoming impatient, not allowing students time to think and giving the answer yourself, or giving them too many clues.

Gayatri Moorthy



# Wild-Life Sanctuaries

For those of you who are interested in organising a wild-life excursion during the Dussehra holidays to places not too far from Delhi, here is some useful information.

**1 Sultanpur :** A water bird sanctuary, close to Delhi and rich in migratory and indigenous birds. It is a source of great attraction for the bird watchers in and around Delhi.

A good time to catch the migratory birds is October to May. The native birds nest from July to October.

**2. Keoladeo Ghana Sanctuary, Bharatpur —** Not too far from Delhi, the place can be reached by road. This is another water bird sanctuary in Rajasthan. From September onwards birds from all over India and even from parts of northern Asia migrate to this place. The best way to see the water birds is to go out by boat. Travelling by bus would be the most convenient for a school excursion. The best season is from October to January. Accommodation arrangements can be made through the Manager, Bharatpur Forest Lodge, Ghana Bird Sanctuary, Bharatpur, Rajasthan 321001. Telephone numbers : 2260, 2864, 2322.

**3. Sariska :** This sanctuary, 200 km from Delhi and 35 km from Alwar, Rajasthan, extends over 210 sq. km. It is a home of tigers, leopard, nilgai, sambar, chital and pigs. February to June are the most suitable months to visit this place.

There is a regular bus service to the sanctuary. The wildlife warden at Sariska sanctuary, Rajasthan can be contacted to assist in the accommodation arrangements. He can also be contacted on telephone at Alwar : 2348.

**4. Sawai Madhopur :** Another game sanctuary in Rajasthan extending over an area of 155 sq km. It harbours leopard, nilgai, chinkara, sambar and chital. About 163 km from Jaipur by road, this place can be reached by train. The best season is from November to May.

A rest house is available for an overnight stay. The wildlife warden, Sawai Madhopur, Rajasthan can be contacted for any kind of assistance.

**5. Corbett National Park :** This 325 sq km park is located in the sub-Himalayan stretch of Uttar Pradesh. It is a home of hog deer, pig, tigers, chitals, elephants, leopard and muntjac. It is most popularly famous for its tigers.

Corbett Park is well connected by road with Delhi. Rest houses are available at Sultan, Gairal, Sarapdul, Bonar, Dhikala, Paterpani, Gaurpani, Malani and Byrani, places all close to the park. The wildlife warden can be contacted for any information required.

**6. Rajaji Game Sanctuary :** Located in the foothills of the Himalayas, the place is 30 km short of Dehra Dun in Uttar Pradesh. It is rich in wild life. The wild life warden at the Forest Lodge, Rajaji Game Sanctuary, is a resourceful person to assist you in planning your excursion.

Photography is permitted in all sanctuaries on payment of a small daily fee. So remember to carry your cameras and binoculars,

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# SOMETHING TO THINK ABOUT

Before the child can be led to any important concepts of Science, it is important to break down certain concepts which already, perhaps, are making their way into his mind through other aspects of his education.

The first is the idea that the textbook is some kind of divine writ, to be accepted without question, swallowed without digestion, and regurgitated in the examination.

The next : that to every question there is one correct answer, and only one correct answer, and that this correct answer must always be given in the words of the book.

The next : that every effect is due to only one cause and not, as so often happens, to a multiplicity of causes.

How can the teacher break down some of these fallacious concepts ? By encouraging the child to ask questions, to conduct experiments for himself and to make guesses. By giving children plenty of practice at suspending their judgements and being prepared to wait and observe rather than to jump to quick conclusions; and even by the teacher and pupils occasionally saying together, "We don't know," followed by, "Let's find out."

—David Horsburgh

(From : Let's Discover Science, Book One)

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